FISHERY RESEARCH

KOOTENAI RIVER FISHERIES INVESTIGATIONS: RAINBOW AND BULL TROUT RECRUITMENT

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Kootenai River Fisheries Investigations: Rainbow and Bull Trout Recruitment

Project Progress Report

2003 Annual Report

By

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ABSTRACT

Rainbow trout *Oncorhynchus mykiss* provide the most important sport fishery in the Kootenai River, Idaho, but densities and catch rates are low. Low recruitment is one possible factor limiting the rainbow trout population. Bull trout *Salvelinus confluentus* also exist in the Kootenai River, but little is known about this population. Research reported here addresses the following objectives for the Kootenai River, Idaho: identify sources of rainbow and bull trout recruitment, monitor the rainbow trout population size structure to evaluate regulation changes initiated in 2002, and identify factors potentially limiting rainbow trout recruitment. A screw trap was used to estimate juvenile redband and bull trout out-migration from the Callahan Creek drainage, and electrofishing was conducted to estimate summer densities of bull trout rearing in the Idaho portion of the drainage. An estimated 1,132 juvenile redband trout and 68 juvenile bull trout out-migrated from Callahan Creek to the Kootenai River from April 7 through July 15, 2003. Densities of bull trout ≥age-1 in North and South Callahan creeks ranged from 1.6 to 7.7 fish/100m^2 in August. Bull trout redd surveys were conducted in North and South Callahan creeks, Boulder Creek, and Myrtle Creek. Thirty-two bull trout redds were located in North Callahan Creek, while 10 redds were found in South Callahan Creek. No redds were found in the other two streams. Modeling of culverts in the Deep Creek drainage identified two as upstream migration barriers, preventing rainbow trout from reaching spawning and rearing habitat. Water temperature monitoring in Deep Creek identified two sites where maximum temperatures exceeded those suitable for rainbow trout. Boulder Creek produces the most rainbow trout recruits to the Kootenai River in Idaho upstream of Deep Creek, but may be below carrying capacity for rearing rainbow trout due to nutrient limitations. Monthly water samples indicate Boulder Creek is nutrient limited as soluble reactive and total dissolved phosphorus were typically at or below detection limits, and dissolved inorganic nitrogen concentrations were <30µ/L. A fall 2003 electrofishing survey of the Kootenai River rainbow trout population showed that the proportional stock density (55) and quality stock density (6) increased for the second year in a row following implementation of more conservative harvest regulations. North and South Callahan creeks support the largest spawning population of bull trout in the Kootenai River drainage, Idaho, so management of the watershed should consider bull trout as high priority. Monitoring of the Kootenai River rainbow trout population size structure should continue for at least two to three years to help evaluate the conservative harvest regulations. Finally, options to improve or increase access to rainbow trout spawning and rearing habitat in the Deep Creek drainage should be investigated.

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INTRODUCTION

The Kootenai River in Idaho has recently lost fisheries for several species, including white sturgeon *Acipenser transmontanus*, burbot *Lota lota*, and kokanee *Oncorhynchus nerka* (Richards 1997). The mountain whitefish *Prosopium williamsoni* population has also declined since the early 1980s (Downs 2000; Walters and Downs 2001; Paragamian 2002). Although no rainbow *O. mykiss* or westslope cutthroat trout *O. clarki lewisi* population data exist prior to 1980, these populations also appear low based on catch rates. Angler catch rates of trout (rainbow and westslope cutthroat) for the Kootenai River, Idaho were 0.06, 0.03, 0.21, and 0.14 fish/h in 1982, 1993, 2001, and 2002, respectively (Partridge 1983; Paragamian 1995a; Hardy 2003; Walters 2003). These rates are low when compared to the Kootenai River, Montana, where trout catch rates of 0.36 to 0.48 fish/h were reported for 1978 and 1979, respectively, the most recent year-round creel data for Montana (May and Houston 1979).

The rainbow trout density in the Kootenai River, Idaho is also low, averaging 47 age-2 and older trout/km (5 trout/ha and standing stock of 1.3 kg/ha) for 1993, 1994, and 1999 (Paragamian 1995a, 1995b; Walters and Downs 2001). In comparison, the average age-2 and older density in the Flower-Pipe reach of the Kootenai River, Montana was 662 trout/km for 1993, 1994, and 1999 (J. Dunnigan, Montana Department of Fish, Wildlife, and Parks [MFWP], personal communication). Lower densities likely contribute to the lower angler catch rates in Idaho. Despite low densities and catch rates, rainbow trout provide the most important fishery in the Kootenai River, Idaho (Paragamian 1995a; Walters 2003).

The low rainbow trout densities in Idaho are hypothesized to result from limited juvenile recruitment to the Kootenai River mainstem from tributaries (Partridge 1983; Fredericks and Hendricks 1997). The Deep Creek drainage produces about 40,000 rainbow trout juvenile out-migrants to the Kootenai River annually, more than all other Idaho tributaries combined (Walters et al. in review). However, most of the Deep Creek out-migrants likely continue migrating downstream to rear in Kootenay Lake, British Columbia (Downs 1999, 2000). Boulder Creek is the second largest source of recruitment to the Idaho reach of the Kootenai River, with an estimated production of only 10,000 juvenile rainbow trout out-migrants/yr (Walters et al. in review). These out-migrants are likely from both fluvial and adfluvial stocks (Idaho Department of Fish and Game [IDFG] unpublished data).

Because Boulder Creek is the largest known source of fluvial rainbow trout recruits to the Kootenai River, Idaho, determining factors limiting juvenile production could aid in enhancing recruitment from this stream. Low nutrient availability in Boulder Creek could limit trout food production and subsequent size and survival of age-0 rainbow trout (Smith and Griffith 1994). Baseline data on nutrient concentrations and size of age-0 rainbow trout in Boulder Creek are needed to assess whether nutrient availability is a possible limiting factor.

Although rainbow trout production in the Deep Creek drainage is the highest of the Idaho tributaries, there is potential to increase this production. For example, juvenile rearing densities in the Deep Creek mainstem are low (7.8 fish/100 m^2) relative to high densities (up to 109 fish/100 m^2) in Deep Creek tributaries (Fredericks and Hendricks 1997). High summer water temperatures were suggested as one factor limiting juvenile rearing densities in Deep Creek (Fredericks and Hendricks 1997). Additional water temperature data are needed to address this factor. In addition, most Deep Creek drainage spawning and rearing habitat is concentrated in Fall, Ruby, and Trail creeks (Partridge 1983). Culverts at road and railroad crossings on

Twentymile creek, a Deep Creek tributary, potentially limit access to more spawning and rearing habitat. These culverts have not been evaluated for fish passage.

The Callahan drainage of Idaho and Montana is also accessible to fluvial and adfluvial salmonids and is known to contain Columbia River redband trout (redband trout; *O. m. gairdneri* Behnke 1992) and bull trout (Knudsen et al. 2002; Walters 2004). Juvenile salmonid recruitment from this drainage has not been measured. Understanding recruitment potential from this drainage will help in prioritizing tributaries for recruitment enhancement measures and conservation.

Additional trout recruitment to the Kootenai River, Idaho from Montana is likely (Downs 2000; Walters and Downs 2001; Walters 2003). Although juvenile out-migration from Montana tributaries has not been investigated, rainbow and bull trout radio tagged in the Kootenai River, Idaho have been tracked to Montana tributaries during the spawning season (Walters and Downs 2001; Walters 2003). An increased sample size of radio-tagged trout may identify more Idaho and Montana spawning tributaries. Identification of spawning tributaries will help prioritize streams for habitat protection or enhancement.

Changes in Kootenai River flows and temperature are known to affect Kootenai River white sturgeon and burbot spawning migration timing (Paragamian 2000; Paragamian and Kruse 2001), but effects on rainbow and bull trout are unknown. If the altered hydrograph and change in water temperatures due to operations of Libby Dam negatively affect trout migration timing, this could ultimately affect spawning and recruitment. More data are needed regarding the timing of trout spawning migrations in relation to flow and temperature.

Another possible factor limiting the Kootenai River rainbow trout population is angling exploitation. Annual exploitation rates of 58% and 46% were documented for 1999 and 2000, respectively (Walters and Downs 2001; Walters 2002). In response to these exploitation rates, more conservative regulations were initiated for the trout fishery. Beginning January 1, 2002, a 16” (406 mm) minimum length limit and two-fish bag limit was established for rainbow and westslope cutthroat trout in the Kootenai River, Idaho. The regulations through 2001 included no size limit and a six-fish bag limit for trout. The goals of the new regulations are to conserve the trout population for continued fishing opportunities, improve the population size structure, and increase trout densities by decreasing angler exploitation and protecting trout until they can spawn at least once. Continued monitoring of the trout population is necessary to evaluate the effects of the new regulations.

Little is known about bull trout in the Kootenai River drainage in Idaho. Densities in the Kootenai River mainstem appear low, based on electrofishing catch rates (<1 bull trout/h) and angler catch rates (<0.05 fish/h) (Walters 2002, 2003; Hardy 2003; IDFG unpublished data). Idaho tributaries appear to have little spawning and rearing habitat with the exception of North and South Callahan creeks. These two streams are known to support bull trout, but densities in the Idaho reaches have not been documented (M. Hensler, MFWP, personal communication). Fluvial (or adfluvial) bull trout were also documented spawning in North and South Callahan creeks in 2002 (Walters 2004). Redd count index reaches should be identified on these streams as a means of monitoring the spawning population annually. More baseline information regarding bull trout spawning locations and recruitment sources is important to documenting recovery needs of this population.

OBJECTIVES

1. Identify sources of rainbow and bull trout recruitment to the Kootenai River, Idaho.

2. Monitor the Kootenai River rainbow trout population size structure to evaluate regulations changes initiated in 2002.

3. Identify factors potentially limiting rainbow trout recruitment to the Kootenai River.

Tasks for 2003 associated with these objectives included measuring redband and bull trout recruitment from the Callahan drainage and measuring redband and bull trout densities in North and South Callahan creeks; monitoring radio-tagged rainbow and bull trout during the spawning period; identifying bull trout redd count index reaches in North and South Callahan creeks; sampling the Kootenai River rainbow trout population structure; identifying potential habitat enhancement areas for spawning and rearing rainbow trout in Deep Creek; documenting nutrient levels in Boulder Creek and associated size and condition of juvenile rainbow trout.

STUDY AREA

The Kootenai River (spelled Kootenay in Canada) flows south out of British Columbia into Montana, northwest into Idaho, then north back into British Columbia and Kootenay Lake (Figure 1). It flows out of the west arm of Kootenay Lake and enters the Columbia River at Castlegar, British Columbia. In the U.S., the Kootenai River is regulated by Libby Dam in Montana (Figure 1). There are approximately 105 km of Kootenai River in Idaho with the following three reaches: 1) the Canyon Reach (22 km) from the Montana border to the Moyie River, 2) the Braided Reach (10 km) from the Moyie River to Bonners Ferry, and 3) the Meandering Reach (73 km) from Bonners Ferry to the Canadian border (Fredericks and Hendricks 1997). The Meandering Reach has a relatively slow velocity and substrates consisting mainly of sand, silt, and clays (Partridge 1983). Dikes on either side of the river in this reach prevent flooding of the adjacent agricultural lands. The Braided and Canyon reaches upstream of Bonners Ferry appear more suitable for fluvial rainbow trout with riffles, runs, and pools, and gravel and cobble substrates. Tributary sampling in 2003 occurred mainly in the Boulder, Callahan, and Deep Creek drainages (Figure 1).

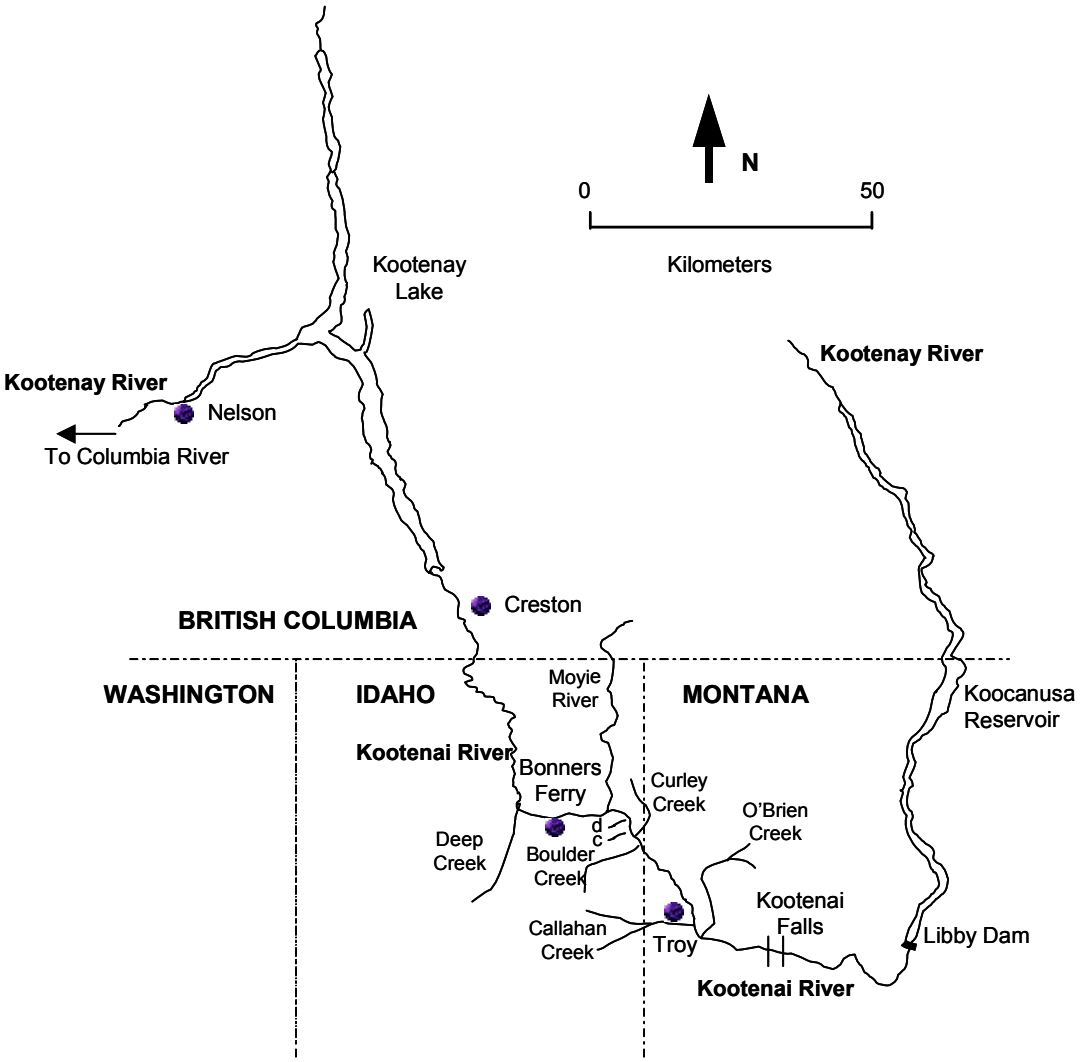

Figure 1. The Kootenai River drainage: "d" is Debt Creek, and "c" is Caboose Creek.

METHODS

Juvenile Redband and Bull Trout Recruitment from the Callahan Drainage

A rotary-screw trap was used to capture juvenile redband and bull trout out-migrating from Callahan Creek in spring and summer 2003 (Thedinga et al. 1994; Kennen et al. 1994). The mainstem Callahan Creek is located in Montana, but the headwaters are in Idaho (Figure 1). The trap was located about 1.6 km upstream from the mouth (UTM zone 11, datum WGS84, Eastings = 058196, Northings = 5366687), near Troy, Montana. Trapped trout were weighed (g) and measured (total length [TL], mm). Trout were marked by clipping a small piece off one of four different fins (lower caudal, anal, upper caudal, or dorsal fin) alternating each week, and released near the first riffle upstream of the screw trap. The proportion of recaptured (fin-clipped) fish to marked fish released upstream of the trap was used to estimate trap efficiency (Thedinga et al. 1994), while the different marks were used to estimate how soon fish were recaptured after being released upstream of the trap. The number of unmarked fish

divided by the trap efficiency was then used to estimate the total number of out-migrants during a given period (strata) (Seelbach et al. 1985; Kennen et al. 1994; Thedinga et al. 1994). Strata were defined as in Downs (1999). Details of methods used to calculate trap efficiencies, out-migrant estimates, and confidence intervals are also found in Downs (1999). Scales were collected from redband and bull trout for aging to determine out-migrant composition by age-class. Nontarget species were weighed and measured and released downstream of the trap. Recaptures of marked trout were released 50 m downstream of the trap.

Passive drift net sampling was conducted on Callahan Creek within 100 m of the mouth to estimate the number of age-0 redband trout out-migrants in summer (Muth and Schmulbach 1984; Walters 2003). Drift net sampling occurred twice weekly from July 22 through August 6. Redband trout were measured to the nearest mm (TL). Age-0 redband trout were identified based on length frequency and on scale ages from a subsample of fish collected. Drift net sampling methods and calculations of out-migrant estimates and confidence intervals were the same as described in Walters (2003).

Redband and Bull Trout Densities in North and South Callahan Creeks

Electrofishing was used in North and South Callahan creeks in August 2003 to estimate redband and bull trout densities in Idaho. Two 50 m reaches of North Callahan Creek and two 150 m reaches of South Callahan Creek were sampled. The upper and lower boundaries of each reach were blocked with a net to keep fish from entering or leaving the reach. Two passes, using two backpack electrofishers, were then conducted for each reach. All fish were netted and held in a bucket. After each pass, fish were counted, measured (TL), and weighed. Fish from the first pass were held in a net pen downstream of the sample reach until the second pass was completed. After selecting a random start point within the first 5 m of each reach, a minimum of six stream width measurements was taken, evenly spaced along the reach. Two-pass removal density estimates and associated 95% confidence intervals were calculated for each species by reach using computer software *MicroFish 2.2* (Van Deventer and Platts 1983).

Rainbow and Bull Trout Spawning Tributary Identification and Migration Timing

Radio telemetry was used to identify Kootenai River tributaries used by rainbow and bull trout spawners and to determine migration timing relative to water temperatures and flows. Five radio-tagged rainbow trout were monitored during the 2003 spawning season, including three tagged in 2002 and two tagged in 2001 (Walters 2002, 2003). Three radio-tagged bull trout were monitored during the 2003 spawning season, including two tagged in previous years (Walters 2002, 2003). The third bull trout was captured by electrofishing near rkm 264 on May 6, 2003. Electrofishing to collect bull trout for radio tagging was conducted between rkm 256 and rkm 276. Electrofishing and telemetry methods were the same as described in Walters (2003). The rainbow trout spawning season (including migration to and from spawning tributaries) was defined as March 1-June 30. The bull trout spawning migration period was defined as June 1-October 30. Radio-tagged trout were usually located once/wk during the spawning periods, either by fixed-wing aircraft or by boat.

Bull Trout Redd Surveys

Bull trout redd surveys were conducted on Boulder, Myrtle, North Callahan, and South Callahan creeks. Stream transects were hiked during midday approximately once every 1-2 weeks to search for redds and spawning adults. Disturbed gravel or cobble areas showing a pit and tailspill were identified as bull trout redds (Shepard and Graham 1983; Dunham et al. 2001). New redds were marked with flagging tape during each stream visit to prevent recounting the same redds. Sizes of observed bull trout were also estimated to the nearest cm total length.

Rainbow Trout Population Size Structure

In fall 2003, rainbow trout were sampled while electrofishing several sections of the Kootenai River from rkm 250 (Cow Creek) to rkm 275 (Boulder Creek). Rainbow trout were measured, weighed, and released. Rainbow trout catch-per-unit-effort, relative weights (W_r), proportional stock density (PSD), and quality stock density (QSD) were then calculated (Anderson 1976; Wege and Anderson 1978; Anderson and Neumann 1996). These variables are measured annually to monitor the rainbow trout population size structure. Relative weights were calculated for rainbow trout length groups of 201-305 mm TL, 306-406 mm TL, and >406 mm TL using the standard weight (W_s) equation for lotic rainbow trout populations proposed by Simpkins and Hubert (1996). Proportional and quality stock densities were calculated for rainbow trout >305 mm TL and >406 mm TL, respectively, using 200 mm TL as stock length (Schill 1991). A 95% confidence interval (CI) was estimated for the PSD using the table provided by Gustafson (1988), but equations were not available to estimate the confidence interval for the QSD.

Rainbow Trout Habitat in Deep Creek

Summer water temperatures were measured in two tributaries to McArthur Reservoir, Dodge and Deep creeks, and at four sites in Deep Creek downstream of the reservoir (Table 1; Figure 2). Optic StowAway® temperature data loggers were used to record water temperatures every 4 h.

Table 1. Locations of temperature data loggers in the Deep Creek drainage, 2003. The UTM coordinates are for zone 11, and the datum = WGS84.

			UTM coordinates		
Stream	**Launch Date**	**Pull Date**	**Eastings**	**Northings**	**Location description**
Dodge Cr.	4/13/03	11/7/03	539900	5374586	Road Crossing 0.5 km upstream of McArthur Reservoir
Deep Cr.	4/13/03	11/12/03	539012	5371555	Road Crossing 1.4 km upstream of McArthur Reservoir
Deep Cr.	4/13/03	10/24/03	541600	5374478	0.5 km downstream of McArthur Reservoir
Deep Cr.	4/13/03	10/24/03	544711	5379296	Highway 95 bridge at Naples
Deep Cr.	1/1/03	10/24/03	544175	5382510	2nd bridge crossing on old Highway 95 north of Naples
Deep Cr.	1/1/03	10/24/03	545173	5386521	1st bridge north of the Deep Creek Inn

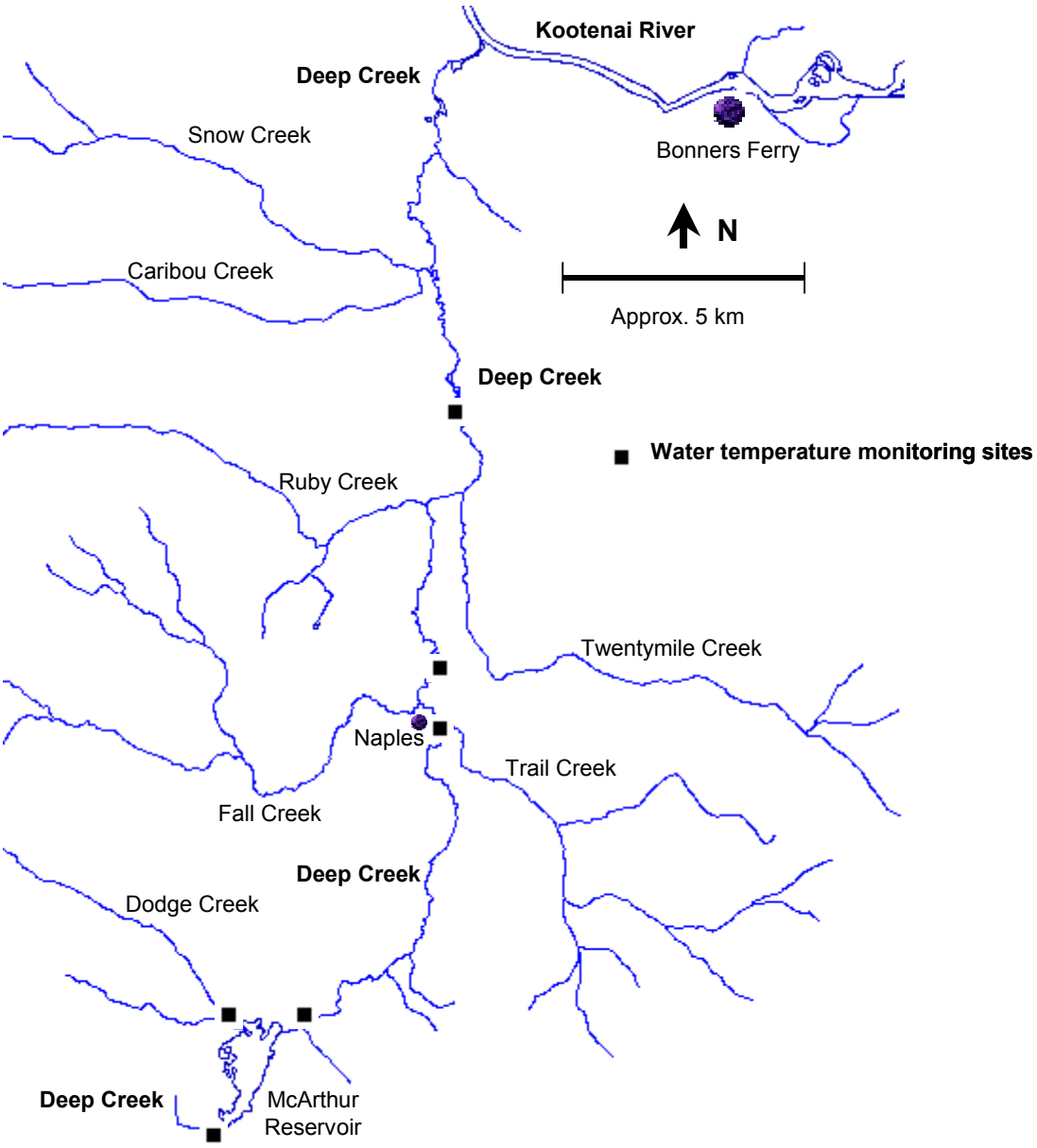

Figure 2. Water temperature monitoring sites in the Deep Creek drainage.

Three crossings on Twentymile Creek, a Deep Creek tributary, were assessed for upstream fish passage using the *FishXing 2.2* software (U.S. Forest Service 1999). The first crossing was a culvert located on Twentymile Road near milepost 0.1, the second crossing was a concrete box structure under the Union Pacific railroad immediately downstream of the Brown Creek confluence, and the third crossing was a culvert under the Union Pacific railroad approximately 0.8 km upstream from the Deep Creek confluence. Structural and hydrological parameters were measured at each crossing site in spring 2003 following methods outlined in the *FishXing* software. Passage conditions for adult rainbow trout (≥300 mm TL) were modeled, but parameters for related species (e.g., cutthroat trout) were sometimes used in the model if the pertinent rainbow trout data was not available in the literature.

Boulder Creek Nutrient Concentrations and Juvenile Rainbow Trout Size

Nutrient concentrations were measured at two sites in Boulder Creek. The upstream site was at the U.S. Forest Service gauging station approximately 5 km from the mouth, while the downstream site was approximately 0.5 km upstream from the mouth. Two water sample replicates were collected from the thalweg at each site once/month from June through September. The samples were kept on ice and shipped overnight to a private lab for analysis. Concentrations of the following nutrients were determined (minimum detection limits in parentheses): Total Phosphorus (0.002 mg/l), Total Dissolved Phosphorus (0.002 mg/l), Soluble Reactive Phosphorus (0.001 mg/l), Ammonia (0.005 mg/l), Nitrate + Nitrite (0.01 mg/l), Total Nitrogen (0.05 mg/l), and Total Organic Carbon (0.250 mg/l).

Backpack electrofishing was conducted in Boulder Creek on November 3, 2003 to determine age-0 and age-1 rainbow trout lengths and weights prior to winter. Three reaches were sampled in an attempt to represent the available habitat types in Boulder Creek. A 3-person electrofishing crew sampled each reach, netting only salmonids. After completing each sample reach, fish were measured (total length in mm) and weighed (nearest 0.1 g), then returned to the stream.

RESULTS

Juvenile Redband and Bull Trout Recruitment from the Callahan Drainage

The screw trap was deployed on April 7 and fished until July 15 when the flow became too low to turn the trap cone. During this period, there were six days the trap could not be operated due to high water and needed repairs. An estimated 1,063 juvenile redband trout and 68 juvenile bull trout out-migrated from Callahan Creek to the Kootenai River from April 7 through July 15, 2003, not including the six days the trap was not fished (Table 2). When the redband trout point estimate is expanded to include the days the trap was not operated, the estimate is 1,132 out-migrants. A total of 94% of redband trout recaptures were caught within three days of being marked, while one fish was recaptured 19 days after being marked. All four bull trout recaptures were caught the day after they were marked. The screw trap catch of redband trout peaked during mid June and early July, while the bull trout catch peaked at the end of June and early July (Figure 3). Length ranges of redband and bull trout out-migrants are shown in Figures 4 and 5, respectively. Most redband trout out-migrants were age-1 and 2, while bull trout out-migrants were mainly age-2 (Table 3). Nontarget species in the catch included longnose dace *Rhinichthys cataractae*, mountain whitefish *Prosopium williamsoni*, and sculpin *Cottus spp*.

Drift net sampling for age-0 redband trout out-migrants from Callahan Creek occurred from July 22 through August 6. Sampling was halted after August 6 due to warm water temperatures and high mortality rates. The age-0 redband trout out-migration peaked on July 31 (Table 4). Lengths of age-0 redband trout caught in drift nets ranged from 22-57 mm. The estimated number of age-0 out-migrants was 1,037 (95% CI = 741-1,332). Nontarget species caught in the drift nets included one bull trout (550 mm TL), longnose dace, sculpin *Cottus spp.*, and unidentified fish larvae.

Table 2. Screw trap efficiencies and estimated numbers of juvenile redband and bull trout out-migrants from Callahan Creek, April 7 through July 15, 2003.

Species	Number of unmarked fish in the catch	Number of marked fish released upstream of the trap	Number of recaptures	Trap efficiency[a]	Lower 95% confidence bound for trap efficiency	Upper 95% confidence bound for trap efficiency	Juvenile out-migrant estimate[b]	Lower 95% confidence bound	Upper 95% confidence bound
Redband trout	138	131	17	0.13	0.07	0.19	1063	732	1942
Bull trout	17	16	4	0.25	0.03	0.47	68	36	508

[a] There was no significant difference in trap efficiency estimates from consecutive strata ($\chi 2$ test, $p > 0.05$), so data were pooled for a single trapping season estimate for each species.

[b] Does not account for 5/25 through 5/28, 6/13, and 7/2 when the trap could not be operated due to high water or needed repairs.

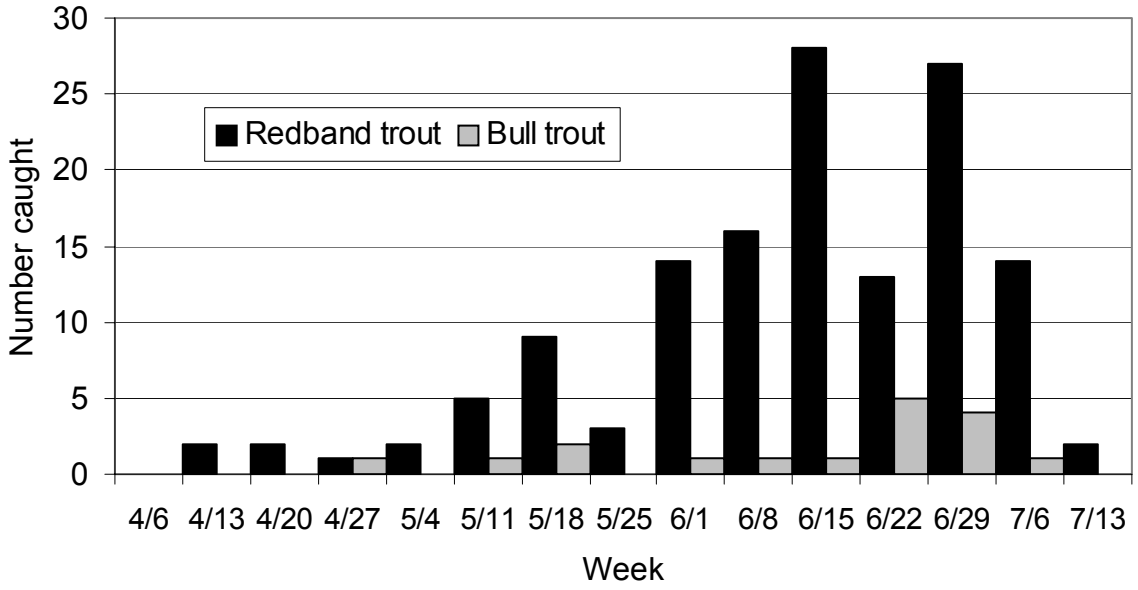

Figure 3. Numbers of juvenile redband and bull trout out-migrants caught with a screw trap from Callahan Creek, April 7 through July 15, 2003. The week of 7/13 included only three sample days, 7/13 through 7/15.

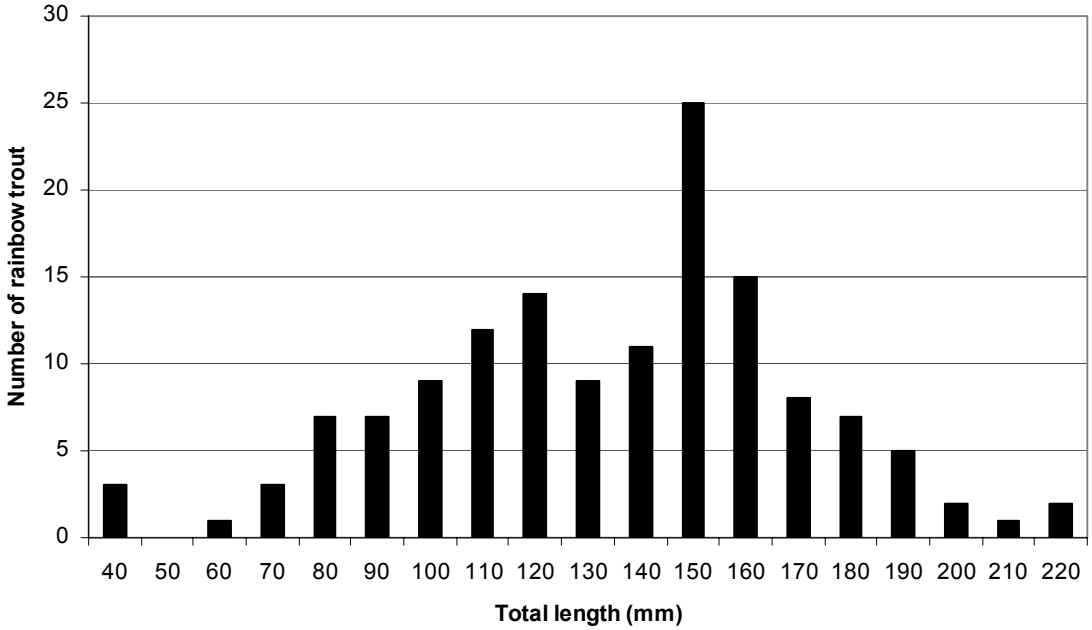

Figure 4. Length distribution of redband trout out-migrants caught with a screw trap, Callahan Creek, April 7 through July 15, 2003.

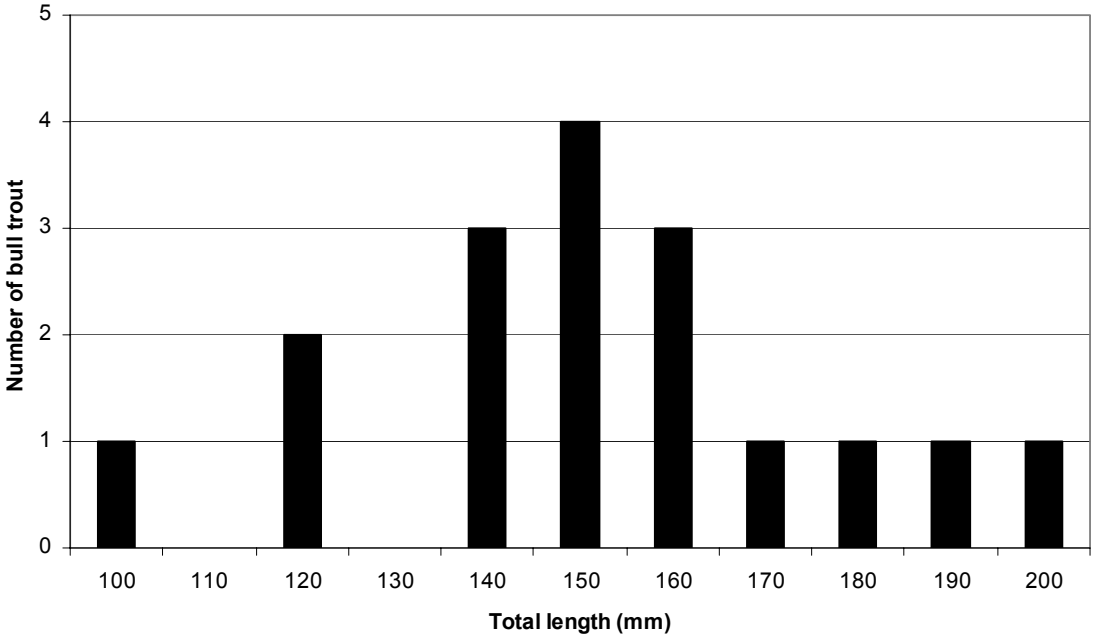

Figure 5. Length distribution of bull trout out-migrants caught with a screw trap, Callahan Creek, April 7 through July 15, 2003

Table 3. Percent of redband and bull trout out-migrants by age group caught with a screw trap in Callahan Creek, April 7 through July 15, 2003.

	Percent of catch that was:				
	Age-1	Age-2	Age-3	Age-4	N
Redband trout	42	52	6	0	110
Bull trout	13	73	7	7	15

Table 4. Estimated number of age-0 redband trout out-migrants from Callahan Creek based on drift net sampling, July and August 2003.

Date	Number of age-0 redband trout caught	Length of age-0 redband trout (mm)			Estimated number of age-0 redband trout out-migrants	Discharge (m^3/s)
		Mean	standard error	N		
7/22	14	—[a]	—[a]	—[a]	64	0.68
7/24	17	38	9.91	17	81	0.66
7/28	2	29	2.12	2	11	0.52
7/31	23	31	8.91	23	84	0.50
8/3	13	29	6.56	12	39	0.46
8/6	5	29	5.10	5	16	0.46

[a] No length data was collected on 7/22.

Redband and Bull Trout Densities in North and South Callahan Creeks

Estimated densities for age-1 and older redband and bull trout in North and South Callahan creeks are given in Table 5. Two bull trout collected in South Callahan Creek were believed to be adults based on length (365 and 610 mm) and are not included in the density estimates. Age-0 fish of both species were also collected (Table 6). The bull trout length frequencies suggest at least three age-classes in each stream (Figure 6), while the redband trout length frequencies suggest at least four age-classes per stream (Figure 7). No other fish species were encountered while sampling.

Rainbow and Bull Trout Spawning Tributary Identification and Migration Timing

A total of five radio-tagged rainbow and three bull trout were monitored in 2003. One rainbow trout moved upstream 2.8 km (from rkm 264.1 to rkm 266.9) between April 28 and May 5, but was never located in a tributary (Table 7). The four remaining rainbow trout showed no spawning migration movements. All three radio-tagged bull trout moved upstream into Montana during the spawning period. Two bull trout were located in O'Brien Creek, Montana, while one was located below Kootenai Falls at rkm 309.5 (Table 7). Upstream movements by bull trout in the mainstem Kootenai River occurred during a decreasing hydrograph (Figure 8).

Bull Trout Redd Surveys

Forty-two bull trout redds were found in 2003, including 32 redds in North Callahan Creek and 10 redds in South Callahan Creek (Table 8). On North Callahan Creek, redds were observed between Jill Creek, Montana and the waterfalls barrier. On South Callahan Creek, most redds were observed within the upstream most 2 km of the survey reach. Fourteen bull trout ranging from 37 to 56 cm in length were observed in North Callahan Creek, while five bull trout ranging from 36 to 56 cm in length were observed in South Callahan Creek. All redds were observed when water temperatures were ≤9 C (Table 8).

Table 5. Bull trout and redband trout densities (≥age-1) in North and South Callahan creeks, August 2003, based on 2-pass backpack electrofishing.

Stream	Species	Transect	Number caught 1st pass	Number caught 2nd pass	Population estimate	Lower 95% CL	Upper 95% CL	Density (n/100 m^2)	Lower 95% CL for density	Upper 95% CL for density
N. Callahan Cr.	Bull trout	1	6	3	9	9	12	2.43	2.43	3.24
		2	6	0	6[a]	-[a]	-[a]	1.64[a]	-[a]	-[a]
	Redband trout	1	24	6	31	30	35	8.36	8.09	9.44
		2	23	7	31	30	35	8.49	8.22	9.59
S. Callahan Cr.	Bull trout	1	28	10	42	38	51	3.54	3.20	4.29
		2	21	16	69	37	152	7.65	4.10	16.86
	Redband trout	1	83	13	97	96	101	8.16	8.08	8.50
		2	56	63	119[b]	-[b]	-[b]	13.20[b]	-[b]	-[b]

[a] A two-pass estimate and confidence intervals could not be calculated because no fish were caught on the second pass. Therefore, the number caught on the first pass was used for a minimum population and density estimate.

[b] A two-pass estimate and confidence intervals could not be calculated because the catch for the second pass was higher than for the first pass. Therefore, the combined catch was used for a minimum population and density estimate.

Table 6. Number, catch per unit effort (CPUE), and length range of bull and redband trout caught by electrofishing in North and South Callahan creeks, August 2003.

Stream	Species	Transect	Pass	Total number caught	Number caught age-0	Number caught ≥age-1	Total CPUE (n/min)	Age-0 CPUE (n/min)	≥age-1 CPUE (n/min)	Length range (mm) Min.	Length range (mm) Max.
N. Callahan Cr.	Bull trout	1	1	12	6	6	0.40	0.20	0.20	78	227
			2	4	1	3	0.17	0.04	0.12	52	163
		2	1	19	13	6	0.46	0.31	0.14	51	183
			2	4	4	0	0.12	0.12	0.00	53	62
	Redband trout	1	1	24	0	24	0.81	0.00	0.81	52	195
			2	6	0	6	0.25	0.00	0.25	84	181
		2	1	27	4	23	0.65	0.10	0.55	33	220
			2	7	0	7	0.21	0.00	0.21	83	203
S. Callahan Cr.	Bull trout	1	1	38	10	28	0.42	0.11	0.31	46	178
			2	13	3	10	0.17	0.04	0.13	42	196
		2	1	30	7	23	0.38	0.09	0.29	46	610
			2	19	3	16	0.32	0.05	0.27	50	158
	Redband trout	1	1	86	3	83	0.96	0.03	0.92	18	229
			2	13	0	13	0.17	0.00	0.17	68	184
		2	1	58	2	56	0.74	0.03	0.72	65	233
			2	63	0	63	1.07	0.00	1.07	69	198

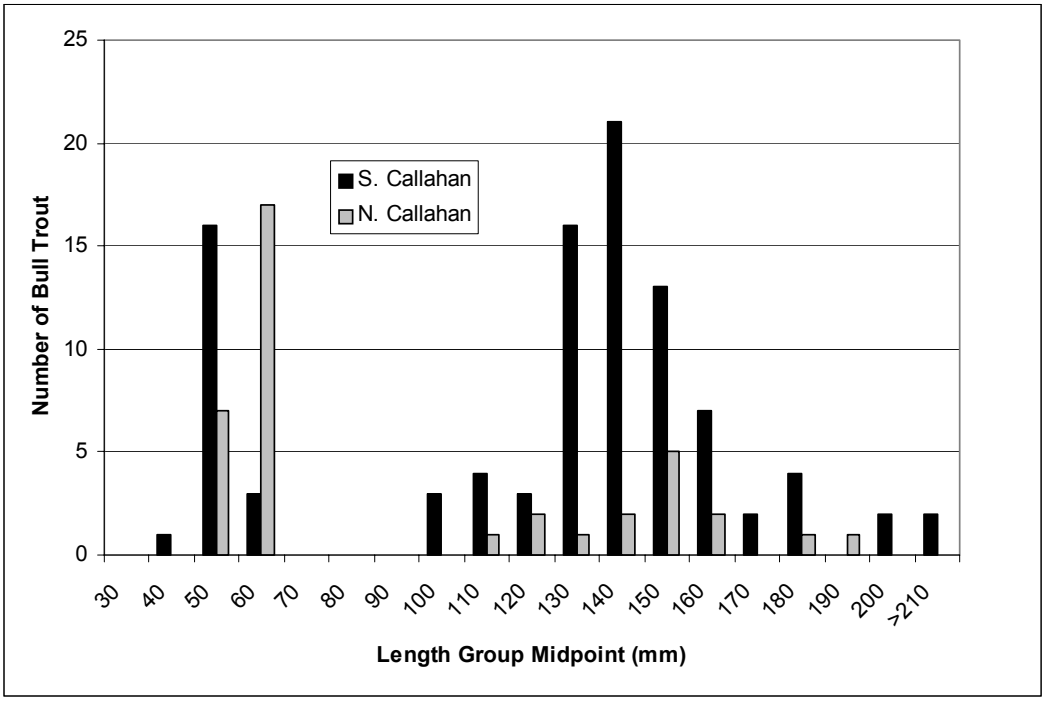

Figure 6. Length frequency of bull trout sampled by electrofishing in North and South Callahan creeks, August 2003.

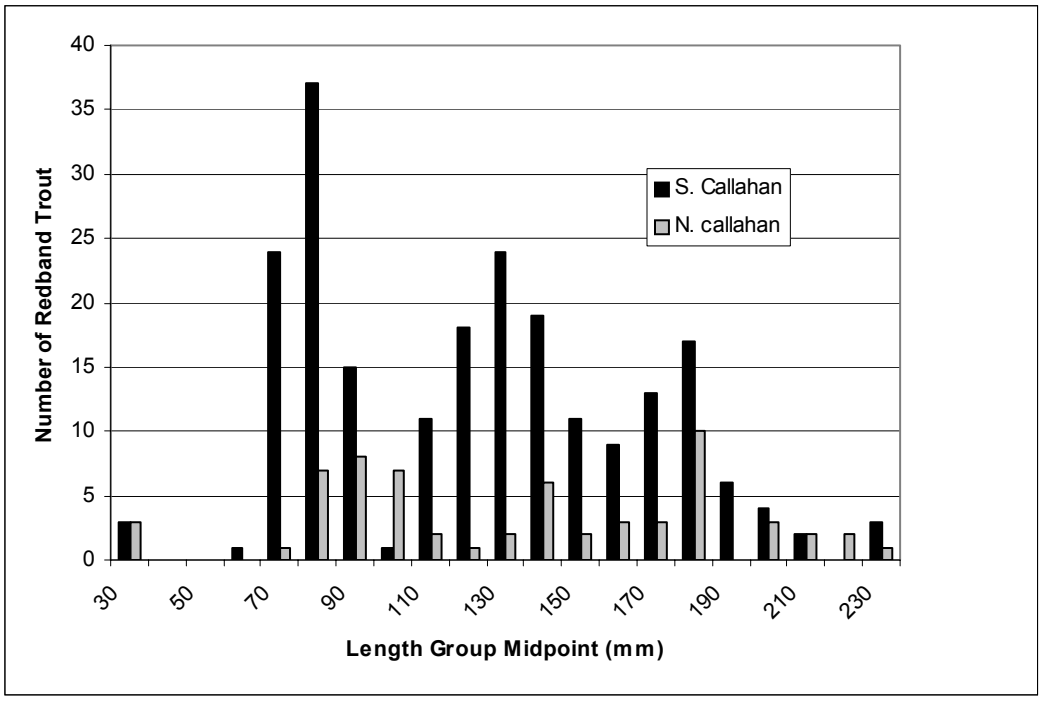

Figure 7. Length frequency of redband trout caught by electrofishing in North and South Callahan creeks, August 2003.

Table 7. Summary of first recorded movements during spawning seasons and first recorded locations in tributary streams for radio-tagged trout, 2003. Bullt = bull trout, Rbt = rainbow trout.

Species	Radio frequency	Tag date	Total length (mm) when tagged	Date of first recorded movement during spawning season	Kootenai R. water temp during first recorded movement (°C)	Date first located in tributary	Name of tributary	Water temp when first located in tributary (°C)
Bullt	30.160	4/23/02	478	6/30	14	8/7	O'Brien Cr.	10.5
Bullt	31.033	3/14/01	581	7/1[a]	14	7/31	O'Brien Cr.	10.6
Bullt	31.882	5/6/03	673	6/23	11	—[b]	—[b]	—[b]
Rbt	31.482	4/23/02	356	5/5	8	—[b]	—[b]	—[b]

[a] Moved sometime between 6/30 and 7/14.
[b] Never located in a tributary

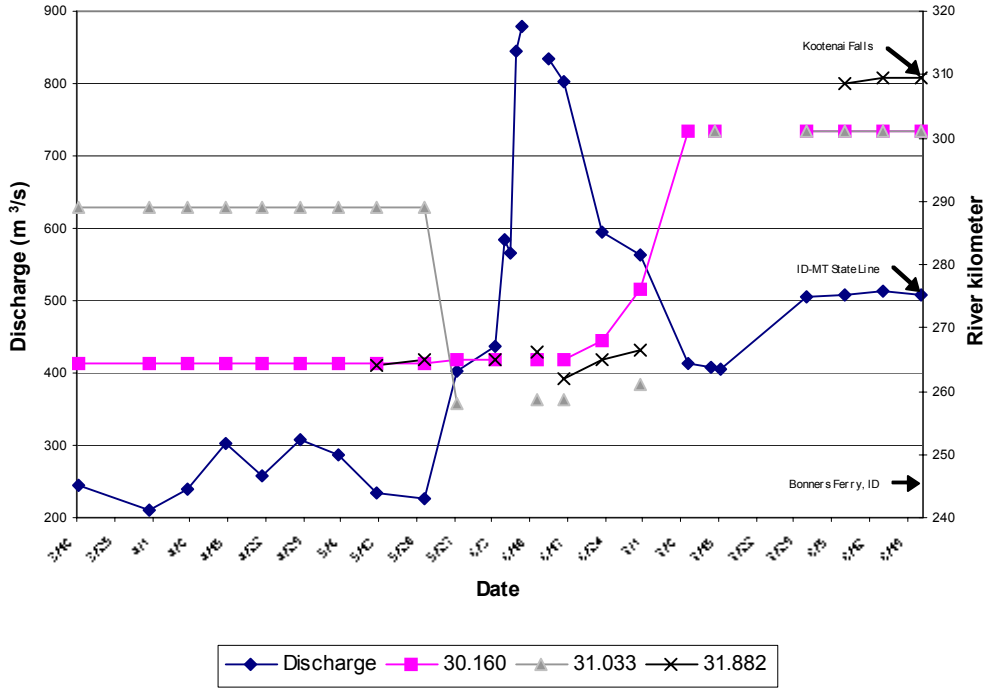

Figure 8. Kootenai River discharge (m^3/s) at Leonia (Idaho-Montana border), and upstream movements of radio-tagged bull trout, March 1 through August 31, 2003 (discharge data from U.S. Army Corps of Engineers).

Table 8. Summary of bull trout redd surveys in the Kootenai River drainage of Idaho, fall 2003.

Stream	Date	Water temp. °C	Transect start point description	Start point UTM coordinates[a] Eastings	Northings	Transect end point description	End point UTM coordinates[a] Eastings	Northings	Number of new bull trout redds
Boulder Cr.	9/19	10.5	Mouth	569849	5386164	Waterfalls 1.9 km upstream of mouth	568641	5385028	0
Boulder Cr.	10/2	8.0	Mouth	569849	5386164	Waterfalls 1.9 km upstream of mouth	568641	5385028	0
Boulder Cr.	10/9	8.0	Mouth	569849	5386164	Waterfalls 1.9 km upstream of mouth	568641	5385028	0
Myrtle Cr.	9/29	10.0	500 m downstream of Westside Rd.	543067	5395676	Myrtle Creek Falls	n. t.	n. t.	0
Myrtle Cr.	10/10	9.0	500 m downstream of Westside Rd.	543067	5395676	Myrtle Creek Falls	n. t.	n. t.	0
N. Callahan Cr.	9/16	8.5	Frezkat Cr.	568983	5366101	Waterfalls barrier	568218	5366538	1
N. Callahan Cr.	9/24	8.0	~500 m downstream of Jill Cr., MT	n. t.[b]	n. t.	Waterfalls barrier	568218	5366538	18
N. Callahan Cr.	9/30	7.0	Jill Cr., MT	n. t.	n. t.	Waterfalls barrier	568218	5366538	10
N. Callahan Cr.	10/8	8.0	Frezkat Cr.	568983	5366101	Waterfalls barrier	568218	5366538	1
N. Callahan Cr.	10/9	7.0	Frezkat Cr.	568983	5366101	Waterfalls barrier	568218	5366538	2
N. Callahan Cr.	10/15	5.5	Jill Cr., MT	n. t.	n. t.	Frezkat Cr.	568983	5366101	0
S. Callahan Cr.	9/15	10.0	Bridge on rd. 4554	570596	5362719	Rd. 414 bridge (trailhead #154)	567347	5360822	0
S. Callahan Cr.	9/25	8.5	Bridge on rd. 4554	570596	5362719	Rd. 414 bridge (trailhead #154)	567347	5360822	7
S. Callahan Cr.	10/1	9.0	~650 m downstream of Glad Cr.	568288	5361245	between Glad Cr. and rd. 414 bridge[c]	567810	5360895	2
S. Callahan Cr.	10/7	8.5	~650 m downstream of Glad Cr.	568288	5361245	between Glad Cr. and rd. 414 bridge[c]	567810	5360895	1

[a] Zone 11; datum = WGS84

[b] n. t. = not taken

[c] a logjam at this sight appeared to be an upstream migration barrier

Rainbow Trout Population Size Structure

Sixty-two rainbow trout were collected during 6.1 h of fall electrofishing effort on the Kootenai River. Total catch-per-unit-effort for rainbow trout was 3.8 fish/h for fish <200 mm TL, 7 fish/h for the 200-305 mm TL group, 7.6 fish/h for the 306-406 mm TL group, and 1 fish/h for fish >406 mm TL. The relative weights for the 201-305 mm TL, 306-406 mm TL, and >406 mm TL size groups were 84 (SE = 1; n = 20), 85 (SE = 1; n = 24), and 83 (SE = 11; n = 3), respectively. The rainbow trout proportional stock density was 55 $\pm$ 16, while the quality stock density was 6.

Rainbow Trout Habitat in Deep Creek

Maximum daily water temperatures were ≥24°C at two Deep Creek sites downstream of McArthur Lake, while daily average temperatures exceeded 22°C at one site (Table 9).

Table 9. Summary of water temperature data for the four Deep Creek temperature logger sites downstream of McArthur Reservoir, 2003.

Site	Number of days avg. temp was ≥22 C	Number of days avg. temp was ≥24 C	Number of days max temp was ≥24 C	Number of days min temp was ≥22 C	Maximum temp °C
Dodge Creek	0	0	0	0	22.1
Deep Creek upstream of McArthur Lake	0	0	0	0	16.3
Deep Creek downstream of McArthur Dam	3	0	1	0	24.4
Deep Creek at Hwy 95 bridge at Naples	0	0	0	0	22.3
Deep Creek approx. 2.5 km downstream of Naples[a]	0	0	0	0	21.7
Deep Creek approx. 1.4 km downstream of the Deep Cr. Inn	0	0	5	0	25.1

[a] No data for 5/2 through 8/20; temperature logger failed.

The *FishXing* model predicted that the two railroad crossings on Twentymile Creek are barriers to upstream movement by adult rainbow trout because of the excessive leap required to enter the structures. The crossing at Twentymile Road would be a velocity barrier when the discharge is ≥0.45 m^3/s. Discharge readings at the Twentymile Road culvert were 0.35 m^3/s and 0.31 m^3/s on May 15 and May 30, 2003, respectively.

Boulder Creek Nutrient Concentrations and Juvenile Rainbow Trout Length

Nutrient concentrations in Boulder Creek were generally below or just above detection limits with the exception of Total Organic Carbon (Table 10). Ninety-one rainbow trout were caught by electrofishing in Boulder Creek during 5,283 s of effort. A length frequency of the catch indicates most of the fish were age-0 and age-1 (Figure 9). Mean length of age-0 rainbow trout was 63 mm TL (Table 11). Summary statistics for the age-0 and age-1 catch are given in Table 11.

Table 10. Nutrient concentrations for Boulder Creek, June through September 2003.

Date	Site	Total phosphorus (mg/l)	Total Dissolved phosphorus (mg/l)	Soluble Reactive phosphorus (mg/l)	Ammonia (mg/l)	Nitrates + nitrites (mg/l)	Total nitrogen (mg/l)	Total organic carbon (mg/l)
6/17	0.5 km from mouth	0.005	0.002	0.001	0.007	0.010	<0.050	1.180
6/17	0.5 km from mouth	0.002	<0.002	0.002	0.009	<0.010	<0.050	1.330
6/17	Gauging station	0.002	0.004	0.001	0.008	<0.010	<0.050	1.380
6/17	Gauging station	0.004	0.004	0.001	0.010	<0.010	<0.050	1.200
7/21	0.5 km from mouth	0.003	<0.002	0.001	0.014	0.013	0.054	1.010
7/21	0.5 km from mouth	<0.002	0.002	<0.001	0.008	0.011	0.073	1.280
7/21	Gauging station	0.002	0.002	<0.001	0.007	0.015	0.086	1.230
7/21	Gauging station	<0.002	<0.002	<0.001	0.008	0.013	0.071	1.040
8/20	0.5 km from mouth	<0.002	<0.002	<0.001	<0.005	<0.010	<0.050	1.070
8/20	0.5 km from mouth	<0.002	<0.002	<0.001	<0.005	<0.010	<0.050	0.933
8/20	Gauging station	0.002	0.002	<0.001	<0.005	<0.010	<0.050	1.250
8/20	Gauging station	<0.002	<0.002	<0.001	<0.005	<0.010	<0.050	1.070
9/23	0.5 km from mouth	0.002	0.003	0.002	0.010	0.015	<0.050	0.983
9/23	0.5 km from mouth	0.003	0.002	0.001	0.012	0.014	<0.050	0.721
9/23	Gauging station	0.003	0.002	<0.001	<0.010	<0.010	<0.050	1.170
9/23	Gauging station	0.002	0.002	<0.001	<0.010	<0.010	<0.050	0.799

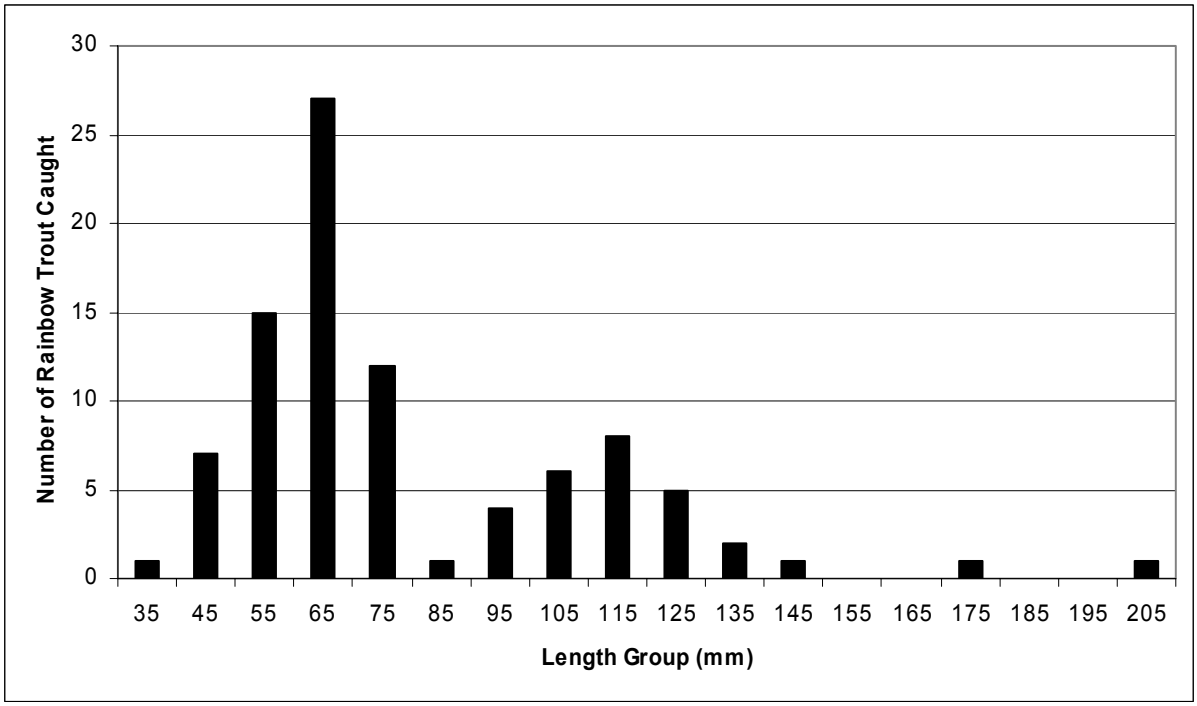

Figure 9. Length frequency of rainbow trout caught by electrofishing in Boulder Creek, November 3, 2003.

Table 11. Summary statistics for age-0 and age-1 rainbow trout caught by electrofishing in Boulder Creek, November 3, 2003.

	Age-0	Age-1
Mean total length (mm)	63	115
Standard Error of the mean	1.2	2.5
Standard Deviation	9.6	12.8
Length range (mm)	40-81	96-146
N	63	26
Length (L) to weight (W) relationship	W = L(0.099352) - 4.12286	W = L(0.361535) - 28.8789
R^2 (significance level) for L-W relationship	0.85 (P <0.001)	0.93 (P <0.001)
Catch per unit effort (n/h)	42.93	17.72

DISCUSSION

The Callahan drainage is a source of juvenile bull trout recruitment to the Kootenai River, but whether these fish continue to rear in the river or in Kootenay Lake remains unknown. Juvenile bull trout densities (1.6 to 7.7 fish/100 m^2) in North and South Callahan creeks are in the lower range of densities reported for other bull trout streams, but are the highest of any Kootenai River tributaries in Idaho (Fraley and Shepard 1989; Paragamian 1995a; Saffel and Scarnecchia 1995). In North Callahan Creek just upstream of the confluence with South Callahan Creek in Montana, juvenile bull trout densities of 0.7/100 m^2 and 3.2/100 m^2 were documented in 2003 and 2004, respectively (J. Dunnigan, Montana Fish, Wildlife and Parks, personal communication).

The total of 42 redds found in North and South Callahan creeks in 2003 was higher than the 17 redds found in 2002 (Walters 2004). However, some redds found in 2003 were in a reach of North Callahan Creek that was not surveyed in 2002 (Jill Creek to 100 m downstream of Smith Creek). The entire reach on North Callahan Creek from Jill Creek upstream to the waterfall barrier should be surveyed annually for bull trout redds. Redd surveys on South Callahan Creek should be conducted from the bridge on Forest Road 4554 upstream to the bridge on Forest Road 414. In North and South Callahan creeks, 94% of redds were constructed by October 7 in 2002 and 2003, while the latest redds were found by October 16 in 2002 and October 9 in 2003 (Table 7; Walters 2004; IDFG unpublished data). Therefore, bull trout redd counts should be conducted about the second week of October in the Callahan drainage when most if not all spawning would be completed.

Resource managers should give top priority to North and South Callahan creeks for bull trout conservation. These appear to be the only two streams in the Idaho portion of the Kootenai River basin with significant bull trout production. At a minimum, bull trout redd numbers should be monitored to index trends in the spawning population.

The redband trout population in the Callahan drainage is likely comprised mostly of resident fish, contributing little recruitment to the Kootenai River. For example, redband trout densities of 121 and 151 fish/100 m^2 have been documented in North Callahan Creek, Montana (J. Dunnigan, MFWP, personal communication), yet the 2003 juvenile out-migrant estimate was only 1,063 fish. In comparison, juvenile rainbow trout rearing densities in the Deep Creek drainage of Idaho range from 7.8 to 109 fish/100 m^2, with about 40,000 juveniles out-migrating from the drainage each year (Fredericks and Hendricks 1997; Downs 1999, 2000). It remains

unknown if redband trout out-migrants from the Callahan drainage rear in the Kootenai River or in Kootenay Lake, British Columbia.

There is potential to restore access to rainbow trout spawning and rearing habitat in the Deep Creek drainage. Two culverts on Twentymile Creek are upstream migration barriers, while a third would be a barrier at flows $\geq$0.45 m^3/s. If these barriers were made passable to upstream migrating fish, about 3 km of potential spawning habitat would be accessible to rainbow trout (Partridge 1983).

Maximum water temperatures exceeded 21°C at all four sites monitored in the Deep Creek mainstem. Carlander (1969) reported an optimum temperature for rainbow trout as below 21°C, while Becker (1983) reported that rainbow trout tended to concentrate where temperatures were between 15.6 and 21.1°C. At two Deep Creek sites, maximum temperatures exceeded 24°C. Laboratory experiments indicate that trout reduce and finally cease feeding as water temperatures rise to between 22 and 25°C (Dickson and Kramer 1971), while young Kamloops rainbow trout acclimated at 11°C died at 24°C (Black 1953). Thus, high summer water temperatures likely reduce rainbow trout rearing potential in Deep Creek.

For the second year in a row, the rainbow trout PSD (55) and QSD (6) were higher than they were prior to implementation of more restrictive trout fishing regulations in 2002, indicating that the current regulations are helping improve population size structure. The 2001 PSD and QSD were 24 and 0, respectively (Walters 2003). The rainbow trout PSD estimate for the Kootenai River, Idaho should be considered in the context of the low-density population. For example, PSD estimates are lower for the rainbow trout population in the Flower-Pipe section of the Kootenai River, Montana, though densities of fish >200 mm are up to an order of magnitude higher than in Idaho (J. Dunnigan, MFWP, personal communication). The higher proportion of juveniles ($\leq$200 mm) resulting in the lower PSD in Montana is likely due to better recruitment than in Idaho. Fishing regulations are more liberal on the Montana section of the Kootenai River with a 4-trout limit including three fish <13 in (330 mm) and one fish >18 in (457 mm).

The maximum length of age-0 rainbow trout in Boulder Creek by November was 81 mm, with most fish under 75 mm. Smith and Griffith (1994) found that rainbow trout <100 mm held in cages in the Henrys Fork Snake River did not survive the winter. It appears that at least some rainbow trout <100 mm can survive the winter in Boulder Creek, as older age classes were also collected, but this overwinter survival rate remains unknown. Age-0 rainbow trout overwinter survival in Boulder Creek would likely increase with increasing size as other salmonid studies have shown (Scrivener and Brown 1993; Smith and Griffith 1994; Meyer and Griffith 1997).

Boulder Creek appears to be nutrient limited as soluble reactive and total dissolved phosphorus were typically at or below detection limits, and dissolved inorganic nitrogen concentrations were <30µ/L (Ashley and Stockner 2003) Therefore, nutrient supplementation could increase biological productivity and rainbow trout growth in Boulder Creek as has been shown with salmonids in other stream studies (Johnston et al. 1990; Peterson et al. 1993). A second year of baseline data on nutrient levels in Boulder Creek would help verify if this stream is annually nutrient limited.

RECOMMENDATIONS

1. Conduct bull trout redd surveys on North and South Callahan creeks about the second week of October.

2. Continue monitoring the Kootenai River rainbow trout population relative to the 16-inch minimum size and 2-fish bag limit.

3. Seek options to improve, or increase access to, rainbow trout spawning and rearing habitat in the Deep Creek drainage.

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